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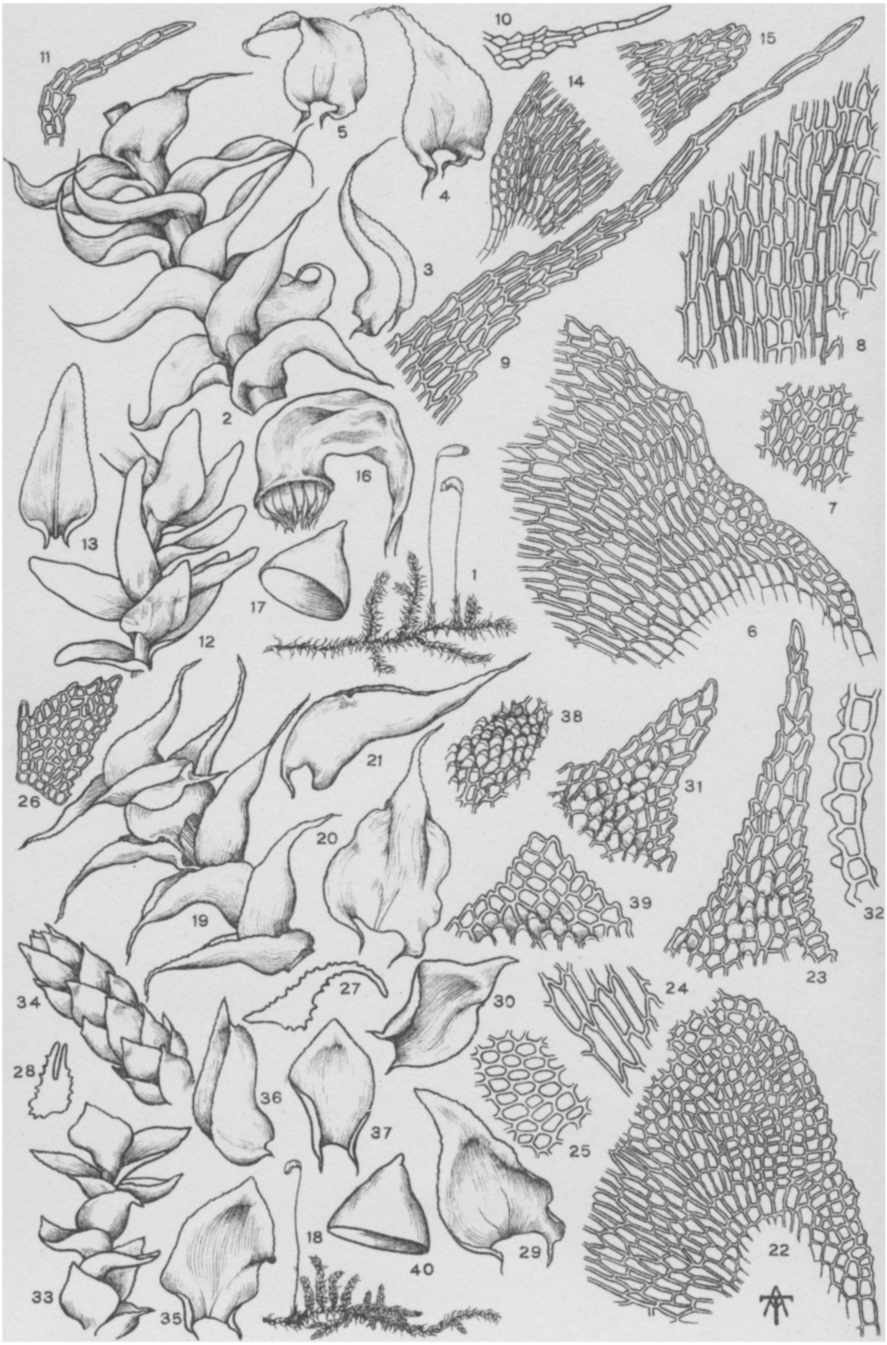

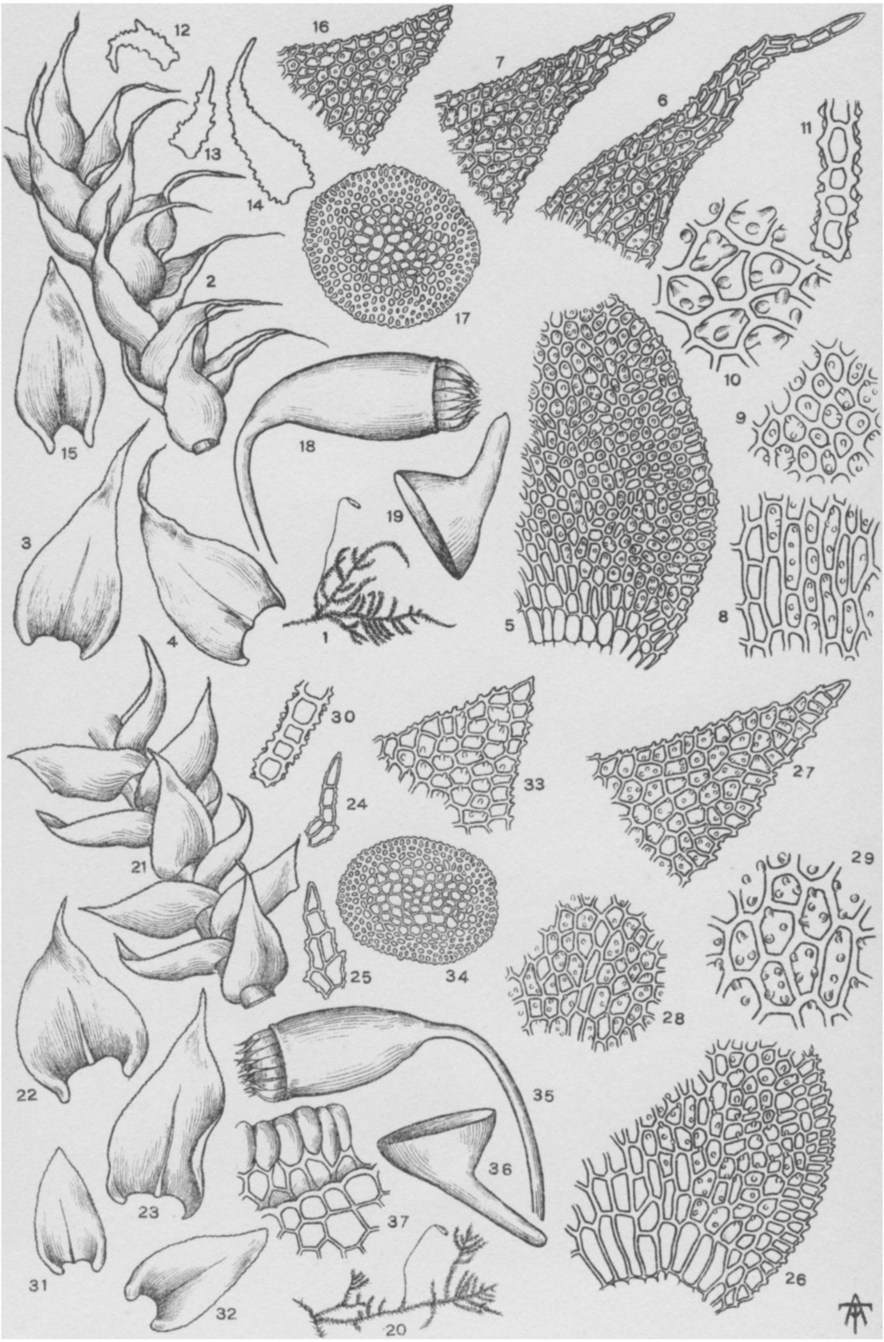

Revision of the North American Species of Heterocladium*

By G. N. Best

(With Plates 13 and 14)

HETEROCLADIUM Bryol. Eur. fasc. 49–51. 1852

Somewhat large to rather small plants growing on stones, rocks, rotten wood and the ground. Stems rigid, stoloniform, sparingly radiculose and paraphyllose, complanately branched; leaves more or less papillose, margins plane and papillose-dentate, costa short, thin, not rarely obsolete; stem leaves triangular-ovate, narrowly acuminate, cordate, subclasping; branch leaves ovate to ovate-lanceolate, acute, obtuse or acuminate; pedicels smooth, capsules inclined to horizontal, short-necked, annulate; exostome well developed; endostomial band one third to one half the length of the teeth with well-developed segments and cilia; operculum conic to rostrate; calyptra cucullate, fugacious.

The short, thin, usually broad costa and the elongated, circumscribed leaf-cells of the basal-central area separate the members of this genus from the closely related *Thuidia*. The *Pseudoleskeae*, while more distinctly plants of high altitudes, in their distribution closely approximate the range of the *Heterocladia*, differing however from these in having their stem leaves plicate with margins recurved and costae well developed.

Key to Species

Leaves smooth.	
Operculum conic.	
Ultimate branch leaves spreading.	*H. procurrens.*
Leaves more or less papillose.	
Ultimate branch leaves imbricate.	*H. squarrosulum*
Operculum rostrate.	
Cells of branch leaves with 2 to 5 papillae.	
Ultimate branch leaves acute or short acuminate.	*H. heteropterioides.*
Cells of branch leaves with 1 to 3 papillae.	
Ultimate branch leaves long to acuminate, secund.	*H. Macounii.*

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* The material on which this revision is based was furnished chiefly by the New York Botanical Garden, the Geological Survey of Canada and the Agricultural Department at Washington. My thanks are due those having these collections in charge and also Mrs. Britton for invaluable assistance, Miss Alexandrina Taylor for the care with which she has executed the drawings and M. Jules Cardot for notes and specimens

1. HETEROCLADIUM PROCURRENS (Mitt.) Rau & Hervey, Cat. 38, 1880

Pterogonium procurrens Mitten, Journ. Linn. Soc. **8** : 37. *pl.* 7. 1865.

Heterocladium procumbens Jaeg. and Sauerb. Adumb. 246.

Hypnum (*Heterocladium*) *procurrens* L. & J. Mosses of N. A. 321. 1884.

Heterocladium aberrans Ren. & Card. Bot. Gaz. **15**: 59. 1890.

Plants rather stout, in spreading tufts, pale green to yellowish green. Stems, with central strand, 4 to 8 cm. long, stoloniform, pinnately branched ; smaller branches simple, attenuate ; larger branches (secondary stems) closely pinnate ; paraphyllia few, linear-lanceolate, serrate : stem leaves scariose, distant, 1.4 to 1.8 mm. long, .6 to .9 mm. wide ; from an erect, auriculo-cordate, subclasping base broadly triangular-ovate, abruptly subfiliform acuminate, spreading-recurved, margins crenate-serrate, costa thin, divided, one branch longer, disappearing below the middle ; larger branch leaves similar, not auriculate, subdistichous, spreading, gradually acute to narrowly acuminate ; smaller branch leaves ovate-lanceolate, lower acute, upper obtuse ; cells of stem leaves smooth, clear, multiform, those of central-basal area linear, obtusely pointed, .006 mm. wide, 4 to 6 times as long, the others broader and shorter, varying from oblong-fusiform to oval-rhombic ; apical cells linear. Dioicous ; perichetial bracts radiculose at base, whitish, outer broadly ovate, inner subvaginant, from an oblong base, long narrowly acuminate, serrate, flexuose-spreading, scarcely costate ; pedicels smooth, flexuose, curved above, about 2 cm. long ; capsules reddish brown, oval-oblong, asymmetric, horizontal, pachydermous, curved and constricted when deoperculate ; urn 1.5 to 2 mm. long, 1 mm. wide ; exothecial cells thick-walled, oval-oblong ; annulus broad, deciduous ; exostomial teeth yellowish, margined, closely articulated, confluent at the reddish base ; endostomial band scarcely one half the length of the teeth ; segments split ; cilia 1 to 3, nodose ; operculum conic, apiculate ; spores smooth, .013 to .016 ; matures in June ; on rocks, more rarely on roots of trees or the ground.

Type locality, North America ; type in Hb. Mitten. British North America, Drummond.

Montana (Holzinger & Blake, Williams) ; Idaho (Leiberg, Sandberg) ; Washington (Allen, Röll) ; British Columbia (Macoun).

EXSICCATI : Ren. & Card. Musc. Am. Sept. 94 as *H. aberrans.*

Macoun Can. Musc. 484 and 692 as *H. homoeopterum.*

Macoun Can. Musc. 498 and 690 as *H. procurrens.*

U. S. Nat. Hb. 138 as *H. aberrans.*

U. S. Nat. Hb. Plants of N. Idaho 1122 as *H. aberrans.*

Holzinger & Blake, Plants of N. W. Montana 47.

The characters of *H. procurrens* are fairly constant and well marked. The leaves, sub-shining and spreading, wet or dry, make its recognition easy. In a few specimens the leaves when dry were erect-spreading but when moistened became spreading. I am indebted to Dr. Mitten for a portion of the type.

2. HETEROCLADIUM SQUARROSULUM (Voit) Lindb. Musc. Scand. 37. 1879

Hypnum squarrosulum in Sturm D. Fl. **2**, fasc. 11. 1810.

Hypnum dimorphum Brid. Spec. Musc. **2**: 149. 1812. Lesq. & James, Manual Mosses N. Am. 321. 1884.

Heterocladium dimorphum Bry. Eur. fasc. 49–51. *t. 479.* 1852.

Plants rather small, in thin spreading tufts, pale yellowish green, rarely deep green. Stems, with rudimentary central strand, 3–6 cm. long, stoloniform, radiculose, irregularly branched; smaller branches simple, larger (secondary stems) pinnate, rarely bipinnate; paraphyllia multiform, roundish ovate to narrowly lanceolate, serrate; leaves of primary stems variable, the lower often rudimentary, the upper obscurely two-ranked, *papillose, subscariose*, .5–.7 mm. wide, .7–.9 mm. long, costa short, thin, divided or bicostate, not rarely obsolete; from a decurrent, cordate, subclasping base broadly round-ovate, abruptly subfiliform acuminate, spreading recurved, margins plane, crenulate-serrulate; leaves of the secondary stems loosely appressed-imbricated when dry, erect-spreading when moist, broadly ovate, serrulate, obtuse to short acuminate; ultimate branch leaves roundish ovate, rounded-obtuse, rarely subacute; leaf cells of the basal-central area of primary stems nearly smooth, clear, linear, about .006 mm. wide, 3–6 times as long, in some passing through the middle into the acumen, in others surrounded by a broad border of shorter cells, varying from roundish quadrate to oblong-oval, with a subcentral papilla on both surfaces; leaf cells of the branch leaves similar, those of the basal-central area shorter, the border cells sometimes hexagonal-quadrate. Dioicous; perichetial bracts radiculose at base, scariose, flexuose-spreading, long acuminate, serrate, inner obscurely costate; pedicels smooth, flexuose, about 1.5 cm. long; capsule curved, horizontal, short-necked, pachydermous, constricted below mouth when deoperculate; urn 1.5 mm. long,

.7 mm. wide ; exothecial cells roundish quadrate to oblong, thick-walled ; teeth of exostome well developed, yellowish, strongly lamellate, confluent at base ; endostomial band nearly one half the length of the teeth ; segments as long as teeth, more or less open ; cilia 1–3, nodose, scarcely appendiculate ; annulus of two rows of large cells, deciduous in pieces ; operculum short, conic, obtuse ; spores smooth, .009–.012 mm.; matures in late winter or early spring ; grows on rocks, roots of trees and on the ground.

From Mt. Washington, New Hampshire (Allen, James), north through Newfoundland (Waghorne), New Brunswick (Moser), Labrador (Waghorne) to Greenland (Fl. Gr.) ; and from Montana (Williams) northwestward. Idaho (Leiberg, Röll); Hector, Rocky Mts. (Macoun). Found in fruit by R. S. Williams and John Moser. Of wide range but rare and local.*

EXSICCATI : Macoun Can. Musc., 660 and 687 as *H. dimorphum.*

Macoun, N. F. Mosses 6 as *H. dimorphum.*

ILLUSTRATIONS : Dixon & Jameson Hand-Book Brit. Mosses *pl. 50.*

Husnot Musc. Gal., *pl. 87.*

Limpricht Die Laubmoose **2** : 817. *fig. 350.*

H. squarrosulum varies considerably from differences in habitat. When appearing on rocks at high altitudes the tufts are usually more compact, the secondary stems and branches subjulaceous and the leaves more obtuse. Growing on roots of trees or on the ground it is more diffuse, the secondary stems not so closely branched and the leaves looser and more acuminate. The subcentral papillae are good diagnostic characters. European bryologists include under *H. squarrosulum* a moss, probably a distinct species, which resembles *H. procurrens.* The leaves of the secondary stems and branches are loosely spreading, deeply concave from an erect base, roundish obtuse, the spores larger and the operculum acuminate. As found in Hb. Jaeger (N. Y. Bot. Gard.) it is 993 of Bryoth. Eur.

3. HETEROCLADIUM SQUARROSULUM COMPACTUM Mol. in Sched.

Pfeffer, Bryogr. Stud. *pl. 71.* 1869

In dense, grayish green tufts. Primary stems stoloniform with rudimentary leaves, not rarely defoliate ; secondary stems ascending-erect, closely branched, branches short, obtuse, terete; leaves when dry appressed-imbricated, round-obtuse, nearly entire, resembling those of *Myurella julacea* but having a different areolation.

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* Renauld & Cardot in Musc. Amer., Sept. 49, 1892, extends the range to Washington.

In Europe on exposed rocks at high altitudes. Collected by J. B. Leiberg, near Lake Pend D'Oreille, Idaho, September, 1889, on slate ledges and distributed as 175, "Mosses from Kootenai County, Idaho."

4. **Heterocladium Macounii** sp. nov.

Plants small, in dense, spreading tufts, yellowish green to golden brown. Stems, without central strand, stoloniform, 3 to 5 cm. long, irregularly branched; stems and branches curved at tips; larger branches (secondary stems) pinnate or bipinnate, often subfasciculate, ascending-erect; paraphyllia few, ovate to linear-lanceolate, serrate; stem leaves close, appressed when dry, erect-spreading when moist, subsecund, narrowly costate to the middle, .3 to .4 mm. wide, .5 to .7 mm long; from a cordate, subclasping base ovate, gradually to abruptly acuminate, spreading, tips recurved, margins plane, papillate-serrulate; larger branch leaves ovate-lanceolate, long acuminate, serrate, more or less secund; cells of the basal-central area of stem leaves sublinear, .005 to .007 mm. wide, 3 to 5 times as long, gradually passing into the quadrate cells of the basal angles and margins and becoming roundish quadrate to rhombic-oblong above, each cell with usually two small papillae on both surfaces near the ends of its long diameter; apical cells of smaller branch leaves quadrate, crowned with two papillae. Dioicous; perichetial bracts whitish, inner long acuminate, flexuose-spreading, serrate; pedicels smooth, shining, flexuose, about 1.5 cm. long; capsules oblong, gradually tapering to a short neck, horizontal, pachydermous, reddish brown, lightly constricted under mouth and subpendant when deoperculate; urn .8 mm. wide, 1.5 to 2 mm. long; exothecial cells elliptical-oblong; exostomial teeth yellowish brown, strongly lamellate, confluent into a reddish basal band; endostomial band nearly one half the length of the teeth; segments somewhat open, as long as the teeth; cilia 1 to 2, nodose-appendiculate; annulus broad, of two rows of cells, deciduous; operculum conic, obliquely rostellate; spores .009 to .012; matures in spring. Grows on rocks.

Type locality, Vancouver Island; type in Herbarium of New York Botanical Garden; collected by John Macoun, June 2, 1893, and distributed as *Heterocladium Vancouveriense* Kindb., Can. Musc. 638.

Although collected at several points on Vancouver Island it does not appear to have been found elsewhere. In its general appearance it resembles *H. squarrosulum*. It is, however, smaller and the branch leaves alone suffice to distinguish one from the other.

Forms analogous to *H. Macounii* are found on the mountains of England, Scotland, Belgium, Germany and probably in the adjoining countries, and are usually referred to *H. heteropterum* (Bruch), from which they differ in being stouter, yellowish green to golden-brown, branch leaves lanceolate, often secund, and leaf-cells longer and narrower. As no capsules were found on the specimens examined their differentiation from both *H. Macounii* and *H. heteropterum* must be based solely on the vegetative characters.

5. **Heterocladium heteropterioides** sp. nov.

Plants quite small, in intricate spreading tufts, dark green. Stems, without central strand, 3–6 cm. long, variously divided and irregularly branched ; larger branches (secondary stems) ascending-erect, pinnate to bipinnate ; branchlets fasciculate, often tufted ; leaves of primary stems erect-spreading, lower sometimes recurved at tips, papillose, .25–.35 mm. wide, .4–.5 mm. long ; from a cordate, subdecurrent base, triangular to ovate-lanceolate, finely pointed, margins plane, papillose-denticulate, costa thin, usually short, rarely narrow and longer, reaching the middle ; leaves of secondary stems appressed when dry, erect-spreading when moist, cordate-triangular, acute to acuminate, margins papillose-serrulate ; ultimate branch leaves ovate, acute to narrowly acuminate ; cells of the basal-central area of stem leaves, not so clearly differentiated as in the preceding species, oblong to sublinear, about .006 mm. wide, 2–4 times as long, those of the basal margins quadrate, passing into oval-oblong above, each cell with 2–5 small, bead-like, irregularly distributed papillae on both surfaces ; apical cells of ultimate branch leaves quadrate to oblong, crowned with 2–4 papillae. Dioicous ; perichetial bracts whitish, flexuose-spreading, inner long and narrowly acuminate, margins denticulate ; pedicels smooth, flexuose-curved, about 1.5 cm. long ; capsule oval, horizontal, short-necked, pachydermous, contracted under mouth when deoperculate ; urn 1.5 mm. long, .7 mm. wide ; exothecial cells thick-walled, oval to oblong ; annulus broad, of 2–3 rows of large cells, deciduous ; exostomial teeth yellowish, strongly lamellate, confluent at base ; endostomial band about one half the length of the teeth ; segments slightly open ; cilia

1–2, nodose; operculum conic-rostrate, straight or oblique, nearly as long as capsule: spores smooth, .010–.012 mm.; matures in summer; grows on rocks and stones in damp places.

Type locality, Washington; type collected by J. A. Allen in Upper Nesqually Valley, Oct. 4, 1898; type with mature capsules.

Idaho (Leiberg); Oregon (Howell); British Columbia (Macoun); Vancouver Island (Macoun).

EXSICCATI: Macoun Can. Musc. 267 and 108 as *H. heteropterum.*

Macoun Can. Musc. 108 as *H. Vancouveriense.*

H. heteropterioides is apparently confined to the Northwest, rare in fruit and often associated with *Hypnum occidentale.* The apical cells of the ultimate branch leaves of the closely related *H. heteropterum* are hyaline, long oval, with a single papilla at their distal ends. The leaf-cells moreover on both surfaces have one or two, usually two, small, rounded papillae near the ends of their long diameters. As this species can be confidently looked for along the Atlantic coast, from Newfoundland northward, these characters will serve to distinguish it from *H. heteropterioides.*

6. **Heterocladium heteropterioides filescens** var. nov.

In widely spreading tufts, dark green passing yellowish green. Stems prostrate, 8–10 cm. long, or longer, sparingly branched; stems and branches filiform; leaves smaller; papillae as in type; sterile.

Type of variety collected by W. B. Wittemeyer in canyon of the Stillaquamish River, Washington, June, 1892. Same range as the type and about as common.

EXSICCATI: Macoun Can. Musc. 688 as *H. heteropterum.*

Resembling the European *H. heteropterum* var. *flaccidum* (Br. & Sch.), var. *fallax* Milde, but differing in being stouter, tufts not so compact, stems longer and leaf cells with more papillae.

DOUBTFUL OR EXCLUDED SPECIES

1. *Heterocladium Vancouveriense* Kindb. Cat. of Canadian Plants **6**: 183. 1892, is *Hypnum occidentale** S. & L., Icon. Musc. Supp. 105. *pl. 81.* 1874.

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* See also The Bryologist, **4**: 13. 1901.

2. *Heterocladium homoeopterum* C. M. & K., distributed as Can. Musc. 484, is *H. procurrens.*

3. *Heterocladium frullaniopsis* C. M. & K. Cat. Canadian Plants **6**: 183. 1892. Mr. John Moser, who is credited with the collecting of this species at Canaan Forks, N. B., writes me that Professor Macoun is unable to find it in his collection and that he has not succeeded in getting a specimen from Dr. Kindberg but kindly sends what he supposes to be a duplicate of the type. This is a rather stout form of *Pterigynandrum filiforme*, approaching the var. *decipiens.*

Explanation of Plates

These plates were drawn from a magnification twice as great as expressed in the numbers which represent the magnification of the figures as they stand in the reproduction.

PLATE 13. HETEROCLADIUM PROCURRENS

1. Plant, natural size.
2. Portion of stem showing arrangement of leaves. × 11½.
3, 4, 5. Outlines of stem leaves. × 11½.
6. Basal portion of stem leaf. × 87½.
7. Cells from middle portion of stem leaf. × 87½.
8. Cells from center of stem leaf; showing the two veins the walls of which are shaded. × 120.
9. Apex of stem leaf. × 87½.
10. Paraphyllium. × 57½.
11. Paraphyllium showing width of walls. × 87½.
12. Ultimate branch showing arrangement of leaves. × 11½.
13. Leaf from ultimate branch. × 15.
14. Basal portion of branch leaf. × 87½.
15. Apex of same. × 87½.
16. Capsule (drawn dry). × 8.
17. Operculum. × 8.

HETEROCLADIUM SQUARROSULUM

18. Plant, natural size.
19. Portion of primary stem showing arrangement of leaves. × 18½.
20, 21. Outlines of primary stem leaves. × 18½.
22. Basal portion of primary stem leaf. × 120.
23. Apex of same. × 120.
24. Central cells from primary stem leaf. × 207½.
25. Marginal cells from the same. × 207½.
26. Paraphyllium showing cells. × 87½.
27, 28. Paraphyllia. × 45.
29, 30. Outlines of secondary stem leaves. × 18½.
31. Apex of secondary stem leaf. × 120.
32. Cross section of secondary stem leaf showing papillae. × 270.

33. Portion of ultimate branch showing arrangement of leaves when moist. × 18½.
34. Portion of ultimate branch showing arrangement of leaves when dry. × 18½.
35, 36, 37. Outlines of ultimate branch leaves. × 25.
38. Oblique view of ultimate branch leaf showing papillae. × 87½.
39. Apex of ultimate branch leaf. × 120.
40. Operculum. × 15.

Plate 14. Heterocladium Macounii

1. Plant, natural size.
2. Portion of secondary stem showing arrangement of leaves. × 18½.
3, 4. Outlines of secondary stem leaves. × 25.
5. Basal portion of secondary stem leaf. × 120.
6. Apex of same. × 120.
7. Apex of some of the secondary stem leaves. × 120.
8. Central cells from secondary stem leaf. × 210.
9. Marginal cells from same. × 210.
10. Marginal cells showing papillæ. × 500.
11. Cross section of secondary stem leaf showing papillæ. × 270.
12, 13, 14. Paraphyllia. × 57½.
15. Outline of ultimate branch leaf. × 35.
16. Apex of ultimate branch leaf. × 120.
17. Cross section of stem. × 57½.
18. Capsule. × 8.
19. Operculum. × 15.

Heterocladium heteropterioides

20. Plant, natural size.
21. Portion of stem showing arrangement of leaves. × 18½.
22, 23. Outlines of stem leaves. × 25.
24, 25. Paraphyllia. × 162½.
26. Basal portion of stem leaf. × 210.
27. Apex of same. × 210.
28. Central cells from stem leaf. × 210.
29. Marginal cells showing papillæ. × 500.
30. Cross section of stem leaf showing papillæ. × 270.
31, 32. Outlines of ultimate branch leaf. × 45.
33. Apex of ultimate branch leaf. × 210.
34. Cross section of stem. × 57½.
35. Capsule. × 8.
36. Operculum. × 11½.
37. Portion of annulus and capsule. × 120.